

CLAIMS

1. A mobile wireless communication system having a public network, a private network and a public wireless LAN system, comprises:

5 a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the
10 mobile wireless terminal apparatus from the public wireless LAN system to the private network;

a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal
15 apparatus to the public wireless LAN system; and

a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server.

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2. A mobile wireless terminal apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which
25 establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with the mobile

wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, a connection authentication server that is installed on the public
5 wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal
10 apparatus and the connection authentication server, comprising:

an authentication processing section that performs authentication processing of connection to the public wireless LAN system to the connection authentication
15 server;

an address acquiring section that acquires an IP address of the virtual private network relay apparatus from the connection authentication server when the connection to the public wireless LAN system is permitted;

20 an address notifying section that notifies an IP address of the mobile wireless terminal apparatus to the connection authentication server; and

an IPsec key exchanging section that performs an IPsec key exchange with the virtual private network relay
25 apparatus using the IP address of the virtual private network relay apparatus.

3. A mobile wireless terminal apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which
5 establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with the mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public
10 wireless LAN system to the private network, a connection authentication server that is installed on the public wireless LAN system and that authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that
15 relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

an authentication processing section that performs
20 authentication processing of connection to the public wireless LAN system to the connection authentication server;

an IPsec shared key acquiring section that acquires an IPsec pre-shared secret key for use in the IPsec key
25 exchange performed with the virtual private network relay apparatus from the connection authentication server when the connection to the public wireless LAN system is

permitted; and

an IPsec key exchanging section that performs the IPsec key exchange with the virtual private network relay apparatus using the IPsec pre-shared secret key.

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4. A mobile wireless terminal apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which
10 establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with the mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public
15 wireless LAN system to the private network, a home agent that controls moving of the mobile wireless terminal apparatus, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal
20 apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

25 an authentication processing section that performs authentication processing of connection to the public wireless LAN system to the connection authentication

server;

an MIP shared key acquiring section that acquires a pre-shared secret key for use in mobile IP registration made with the home agent from the connection authentication server when the connection to the public wireless LAN system is permitted; and

an MIP registering section that makes the mobile IP registration to the home agent using the pre-shared secret key.

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5. A mobile wireless terminal apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with the mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, a home agent that controls moving of the mobile wireless terminal apparatus, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between

the mobile wireless terminal apparatus and the connection authentication server, comprising:

an authentication processing section that performs authentication processing of connection to the public
5 wireless LAN system to the connection authentication server;

an address acquiring section that acquires an IP address of the virtual private network relay apparatus from the connection authentication server when the
10 connection to the public wireless LAN system is permitted;

an address notifying section that notifies an IP address of the mobile wireless terminal apparatus to the connection authentication server;

an IPsec shared key acquiring section that acquires
15 an IPsec pre-shared secret key for use in the IPsec key exchange performed with the virtual private network relay apparatus from the connection authentication server;

an MIP shared key acquiring section that acquires an MIP pre-shared secret key for use in mobile IP
20 registration made with the home agent from the connection authentication server;

an IPsec key exchanging section that performs exchange of the IPsec key with the virtual private network relay apparatus using the IPsec pre-shared secret key;
25 and

an MIP registering section that makes the mobile IP registration to the home agent using the MIP pre-shared

secret key.

6. A virtual private network relay apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises the virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus, and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN' performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

an address acquiring section that receives an IP address of the mobile wireless terminal apparatus from the connection authentication server; and

an IPsec key exchanging section that performs an IPsec key exchange with the mobile wireless terminal apparatus using the IP address of the mobile wireless terminal apparatus.

7. A virtual private network relay apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and
5 comprises the virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection
10 of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to
15 the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:
20 an IPsec shared key acquiring section that acquires a pre-shared secret key for use in an IPsec key exchange performed with the mobile wireless terminal apparatus from the connection authentication server; and
an IPsec key exchanging section that performs the
25 IPsec key exchange with the mobile wireless terminal apparatus using the pre-shared secret key.

8. A virtual private network relay apparatus in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises the virtual private network relay apparatus
5 which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and
relays connection of the mobile wireless terminal
10 apparatus from the public wireless LAN system to the private network, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless
15 LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

an address acquiring section that receives an IP
20 address of the mobile wireless terminal apparatus from the connection authentication server;

an IPsec shared key acquiring section that receives a pre-shared secret key for use in the IPsec key exchange performed with the mobile wireless terminal apparatus
25 from the connection authentication server; and

an IPsec key exchanging section that performs the IPsec key exchange with the mobile wireless terminal

apparatus using the IP address of the mobile wireless terminal apparatus and the pre-shared secret key.

9. A connection authentication server in a mobile
5 wireless communication system which has a public network,
a private network and a public wireless LAN system and
comprises a virtual private network relay apparatus which
establishes an IPsec tunnel with a network relay apparatus
installed on the private network via the public network,
10 further establishes the IPsec tunnel with a mobile
wireless terminal apparatus and relays connection of the
mobile wireless terminal apparatus from the public
wireless LAN system to the private network, connection
authentication server that is installed on the public
15 wireless LAN system and authenticates connection of the
mobile wireless terminal apparatus to the public wireless
LAN system, and a wireless LAN access point that relays
connection authentication procedures of a public wireless
LAN performed between the mobile wireless terminal
20 apparatus and the connection authentication server,
comprising:

an authentication processing section that
authenticates connection of the mobile wireless terminal
apparatus to the public wireless LAN system;

25 an address acquiring section that receives an IP
address of the mobile wireless terminal apparatus from
the mobile wireless terminal apparatus when permitting

the connection of the mobile wireless terminal apparatus to the public wireless LAN system; and

an address notifying section that notifies an IP address of the virtual private network relay apparatus to the mobile wireless terminal apparatus and notifies the IP address of the mobile wireless terminal apparatus to the virtual private network relay apparatus.

10. A connection authentication server in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, the connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

an authentication processing section that

authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system; and

an IPsec shared key distributing section that distributes a pre-shared secret key, for use in an IPsec
5 key exchange performed between the mobile wireless terminal apparatus and the virtual private network relay apparatus, to the mobile wireless terminal apparatus and the virtual private network relay apparatus when permitting the connection of the mobile wireless terminal
10 apparatus to the public wireless LAN system.

11. A connection authentication server in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and
15 comprises a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network , further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the
20 mobile wireless terminal apparatus from the public wireless LAN system to the private network, a home agent that controls moving of the mobile wireless terminal apparatus, the connection authentication server that is installed on the public wireless LAN system and
25 authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication

procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:

an authentication processing section that authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system; and

an MIP shared key distributing section that distributes a pre-shared secret key, for use in mobile IP registration performed between the mobile wireless terminal apparatus and the home agent, to the mobile wireless terminal apparatus and the home agent when permitting the connection of the mobile wireless terminal apparatus to the public wireless LAN system.

12. A connection authentication server in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, a home agent that controls moving of the mobile wireless terminal apparatus, the connection authentication server that is installed on the public wireless LAN system and

authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between
5 the mobile wireless terminal apparatus and the connection authentication server, comprising:

an authentication processing section that authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system;

10 an address acquiring section that receives an IP address of the mobile wireless terminal apparatus from the mobile wireless terminal apparatus when permitting the connection of the mobile wireless terminal apparatus to the public wireless LAN system;

15 an address notifying section that notifies an IP address of the virtual private network relay apparatus to the mobile wireless terminal apparatus and notifies the IP address of the mobile wireless terminal apparatus to the virtual private network relay apparatus;

20 an IPsec shared key distributing section that distributes an IPsec pre-shared secret key, for use in an IPsec key exchange performed between the mobile wireless terminal apparatus and the virtual private network relay apparatus, to the mobile wireless terminal
25 apparatus and the virtual private network relay apparatus; and

an MIP shared key distributing section that

distributes an MIP pre-shared secret key, for use in mobile IP registration performed between the mobile wireless terminal apparatus and the home agent, to the mobile wireless terminal apparatus and the home agent..

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13. A wireless LAN access point in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which
10 establishes an IPsec tunnel with a network relay apparatus installed on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public
15 wireless LAN system to the private network, a home agent that controls moving of the mobile wireless terminal apparatus, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal
20 apparatus to the public wireless LAN system, and the wireless LAN access point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server, comprising:
25 an authentication relay section that transmits to the mobile wireless terminal apparatus an IP address, an IPsec pre-shared key and a Mobile IP pre-shared key

transmitted from the connection authentication server and transmits an IP address transmitted from the mobile wireless terminal apparatus to the connection authentication server, using a secure communication path
5 established in the connection authentication procedures of the public wireless LAN performed between the mobile wireless terminal apparatus and the connection authentication server.

10 14. A home agent in a mobile wireless communication system which has a public network, a private network and a public wireless LAN system and comprises a virtual private network relay apparatus which establishes an IPsec tunnel with a network relay apparatus installed
15 on the private network via the public network, further establishes the IPsec tunnel with a mobile wireless terminal apparatus and relays connection of the mobile wireless terminal apparatus from the public wireless LAN system to the private network, the home agent that controls
20 moving of the mobile wireless terminal apparatus, a connection authentication server that is installed on the public wireless LAN system and authenticates connection of the mobile wireless terminal apparatus to the public wireless LAN system, and a wireless LAN access
25 point that relays connection authentication procedures of a public wireless LAN performed between the mobile wireless terminal apparatus and the connection

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authentication server, comprising:

an MIP shared key acquiring section that receives
a pre-shared secret key for use in mobile IP registration
of the mobile wireless terminal apparatus from the
5 connection authentication server; and

an MIP processing section that processes the mobile
IP registration from the mobile wireless terminal
apparatus using the pre-shared secret key.